

RETROSPECTIVE COMPARISON OF PARATRICIPITAL APPROACH AND TRICEPS SPLITTING APPROACH FOR THE MANAGEMENT OF CUBITUS VARUS BY CORRECTIVE OSTEOTOMY

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Corrective osteotomy for cubitus varus deformity can be approached both via triceps splitting approach as well as paratricipital approach. The aim of our study was to compare the functional outcome after triceps splitting and paratricipital approach for corrective osteotomy in cubitus Varus deformities. This is a retrospective study done on cases operated between January 2001 and December 2015. A total of 40 patients presented with cubitus varus deformity. Exclusion criteria removed 10 patients from the study. Of the 40 patients, 22 patients had been operated with a triceps splitting approach while 18 patients had been operated with a paratricipital approach. Retrospectively data was extracted. Our final data consisted of 40 cases. All the twenty-two cases in group A were fully satisfied with cosmetic results, but one case in group B had complaints related to cosmetic appearance due to excessive lateral condylar prominence. In group A, there was no pain in seventeen, mild pain in three, moderate pain in two cases and none had severe pain. In group B, there was no pain in fifteen, mild pain in two, moderate pain in one case and none had severe pain. No case had instability in the coronal plane. As compared to triceps splitting approach, paratricipital approach results in better functional outcomes, triceps strength, elbow ROM and less extension contracture in the final follow up.

Key words: *triceps splitting, paratricipital approach, functional outcomes, cubitus varus deformity, closed wedge osteotomy.*

Introduction. Corrective osteotomy for cubitus varus deformity can be approached both via triceps splitting approach [1] as well as paratricipital approach [2]. The paratricipital approach is actually an extension of the approach described by Alonso-Llames [3]. These approaches are the standard workhorse for various distal humerus procedures [4]. The approaches have also been compared in various extra articular interventions including distal humerus fractures [5]. Osteotomy for cubitus varus deformity correction presents its own set of challenges [6]. The choice of approach has presently been dictated primarily by surgeon preference. A triceps splitting approach has its own merits and demerits. None of the previous studies have compared the approaches head to head when dealing with osteotomy for cubitus varus deformities. The aim of the current study was to compare patients who were operated for cubitus varus deformity correction with lateral close wedge osteotomy using a paratricipital or triceps-splitting approach, in regard to joint range of motion (ROM), triceps extension strength, and functional results.

The aim of our study was to compare the functional outcome after triceps splitting and paratricipital approach for corrective osteotomy in cubitus Varus deformities.

Object and methods of research. Between January 2020 and January 2022 a retrospective evaluation was made of the patients records who were operated by the four lead surgeons in various capacities at various times between 2001 and 2020.

In these patients, after the diagnosis had been established, the decision for surgery had been taken after due clinical and radiological evaluation. The surgeries were performed by the lead author and three of his co-authors. The patients had been placed in lateral decubitus position with the arm placed into a horizontal position in 90° of abduction from the shoulder along with a radiolucent padding support, providing for flexion of the elbow. No

tourniquets were used in the surgeries, rather meticulous coagulation and hemostasis had been preferred. The patient's follow-up data were separated into triceps-split or paratricipital groups, according to the surgical approach, which was applied as per the surgeon's preference at the time of surgery.

In the posterior triceps-splitting approach (Campbell), a longitudinal incision centered on the junction of the middle and distal thirds of the humeral shaft was made. Incisions avoided the tip of the olecranon. Full-thickness fasciocutaneous flaps were elevated to protect the cutaneous nerves. The triceps tendon was split in the midline from the tip of the olecranon to an upper limit as per the requirement of the operating surgeon based on the level of the osteotomy (between the long and lateral heads of the triceps). Soft tissue retraction provided adequate view for the posterior aspect of the distal humerus.

In the Posterior paratricipital approach (Alonso-Llames), the incision was centered on the junction of the middle and distal thirds of the humeral shaft. The incision over the tip of the olecranon was avoided by making it curvilinear. Here too, full-thickness fasciocutaneous flaps were elevated to protect the cutaneous nerves. The ulnar nerve proximally along the medial border of the triceps. The ulnar nerve was released superficially through the cubital tunnel up until the first motor branch. The nerve was transposed or left in situ according to the surgeon's preference. The triceps fascia was split and the muscle belly mobilized from the lateral intermuscular septum and humerus towards the ulnar side. To maximize the exposure distally, only the posterior band of the medial collateral ligament on the medial aspect of the ulnohumeral joint was incised if required. On the lateral side, only the posterolateral capsule on the lateral side of the ulnohumeral joint was incised if required. Lateral closed wedge osteotomy had been performed in all the cases. This was done as per pre-operative templates. In all the

cases stabilization was done using internal fixation. Post-operative immobilization consisted of above elbow slabs or cast for a duration of three weeks. The length of duration for which follow up was available for all the cases was two years.

Research results. Our final data consisted of 40 cases (table 1). 12 cases had already been excluded from the study due to lack of follow up data or the patient not meeting the strict inclusion criteria. The data was segregated into two groups depending on whether the surgery had been performed using a triceps-split approach (Group A) or a paratricepetal approach (Group B). The humeral-ulnar angle was used rather than the Baumann's angle as many patients had reached skeletal maturity (making accurate assessment by the latter method difficult). Primarily, two types of outcome measurements were made. Morrey's system of functional assessment of outcome had been primarily used by the surgeons to assess the outcomes (table 2). Other than this, an osteotomy that corrected the humeral – ulnar angle to less than 10 degrees of the contralateral side was considered a good result. Those that were more than 10 degrees in comparison to the contralateral side were deemed as poor results. Hence all the cases that had a good radiological outcome also had a good cosmetic clinical outcome and all the cases that had poor radiological outcomes also had poor cosmetic clinical outcomes.

All the twenty-two cases in group A were fully satisfied with cosmetic results, but one case in group B had complaints related to cosmetic appearance due to excessive lateral condylar prominence. All the cases resumed their normal activity within four to seven months of surgery in both the groups. The radiological union at the osteotomy site took place in a mean period of 7.5 weeks (range 6 to 9 weeks) in Group A, while it was 7.0 weeks (range 6 to 9 weeks) in Group B. Post operatively flexion improved to (145.0±5.0) in group B compared to (130.0±4.0) in group A with a p=0.001. Extension contracture was also reduced in paratricepetal (5.0±6.0) group B as compared to triceps splitting group (14.0±6.0) group A with p<0.001 (table 3). The hyperextension measured preoperatively in one case in each group was 12 and 15 degrees, improved to normal postoperatively. In group A, there was no pain in seventeen, mild pain in three, moderate pain in two cases and none had severe pain. In group B, there was no pain in fifteen, mild pain in two, moderate pain in one case and none had severe pain. No case had instability in the coronal plane.

Eighteen (80%) patients showed excellent results, three (15%) good while none showed fair or poor results in the follow-up. Statistical analysis was not done due to the small study group. None of our patients had any neurovascular deficit postoperatively. None reported infections, gross loss of fixation, and loss of correction.

Average preoperative Varus was 23.5 degrees (range 15-28), immediate postoperative and 3-month postoperative valgus angle measured 14.5 degrees (range 12-17

Table 1 – Demographic data of two groups

	Triceps split approach A	Paratricepetal approach B
No of patients	22	18
Male / Female	12/10	10/8
Injured arm (right arm/left arm)	14/8	12/6
Mean age (in years)	18 +/- 12	20 +/- 10

degrees). The radiological valgus achieved on the operated side was near equal to valgus of normal side with a mean variation of ±1.91 degrees (range – 2 in case no. 20 to + 4 degrees in case no. 10 at 12-week follow-up (table 3)). Cosmetically all except 1 patient from group B were satisfied with the outcome. There had been no neurovascular complication, or any unsightly. Stable fixation had led our most of the cases to achieve >165 degree of supination-pronation, <10-15 degrees of restriction of flexion-extension in most of the cases. Most of the patients were able to regain their pre-injury functional status the tenth week postoperatively with excellent cosmetic correction.

Discussion of research results. Till date, neither triceps-splitting nor paratricepetal approach is considered superior to the other approach. Mostly, the experience of the surgeon and the type of fracture determine the preferred incision to be employed. The aim of this study was to compare the clinical and functional outcome of cubitus varus deformities treated with lateral open wedge osteotomies using either a triceps splitting approach or a paratricepetal approach. Many complications have already been reported in literature for corrective osteotomies done in cases of cubitus varus deformity [7]. These include infections, brachial artery aneurysms, loss of fixation, inadequate fixation, inadequate correction of malalignment, stiffness and nerve palsy [8]. How many

Table 2 – Morrey's system of functional assessment of outcome

	None	Mild	Moderate	Severe
Pain		If patient had occasional pain during use of the elbow but took no medication	If patient had pain at night occasionally took medication for pain but elbow did not limit the activity of daily living	If the patient took medication for pain regularly and activities of daily living were impaired
Stability		If varus valgus laxity was estimated to be less than 5 degrees and was not associated with any symptoms;	If varus valgus laxity was estimated to be less than 5-10 degrees and was associated with mild symptoms	If varus valgus laxity was estimated to be more than 10 degrees and was associated difficulty in activity of daily living
Motion	Flexion and extension of the elbow were measured with a hand goniometer held along the lateral aspect of the brachium and forearm. Pronation and supination were measured at the extremes of active motion, with one arm of the goniometer held along or parallel to the brachium and the second arm placed parallel to the dorsum or the volar aspect of the wrist			
Strength	Strength of flexion and extension was measured isometrically in all patients			

Table 3 – Comparison of clinical outcomes between two groups

Indices	Triceps split approach A	Paratricepetal approach B
Range of elbow flexion	(126.0±10.0)	(140.0±4.0)
Range of elbow extension contracture	(24.0±8.0)	(5.0±6.0)
Triceps Strength	88±20	66±16
DASH score	7.5±3.0	12.0±4.0

of these complications may be associated with an inappropriate approach is an unknown variable. For proper osteotomy and fixation in case of cubitus varus deformity, an appropriate surgical approach is of utmost importance. Previously, various authors have compared triceps splitting approach with paratricepetal approach [9]. But mostly these studies were restricted to extra articular distal humerus fractures and humerus shaft fractures. Our study here focused on osteotomies for cubitus varus deformity correction.

In the paratricepetal approach, the triceps muscle is protected, and a surgical working area with less bleeding for better visualization even without a tourniquet is provided. As the triceps is not incised directly, there less scar formation, the triceps strength is theoretically not reduced postoperatively, and therefore contracture of the elbow does not develop. However, the triceps sparing incision is technically demanding and, because the mobilization of the triceps is somewhat restricted, the surgical maneuvers becomes similarly challenging [10].

Remia et al. directly compared a triceps sparing approach to a triceps splitting approach. They used triceps sparing approach described by Bryan and Morrey in nine of their patients with AO/OTA TYPE C distal humerus fractures and triceps splitting approach in 6 patients with AO/OTATYPE C distal humerus fractures [11]. They came to the conclusion that there was no difference in elbow ROM or triceps deficit. They did not take into account functional outcomes. Emmanuel et al. on the other hand compared the outcomes after triceps splitting versus tri-

ceps sparing approaches in extra articular distal humerus fractures (AO/OTA TYPE A)¹¹. They reported better elbow ROM and triceps strength with triceps sparing approach as compared to triceps splitting approach. However both these approaches had similar functional outcome as per DASH scores. Our study showed better ROM, less extension contracture as well as better functional outcomes in the paratricepetal group in comparison to the triceps splitting group.

The limitations of our study include the fact that the sample size is small and the choice of surgical approach was based solely on the discretion of treating surgeon.

Conclusions. Both the triceps splitting as well as the paratricepetal approach can be used to. Both the approaches result in almost similar operative times but the paratricepetal approach results in better functional outcomes, triceps strength, elbow ROM and less extension contracture in the final follow up. We therefore recommend the paratricepetal approach for lateral closed wedge osteotomies in the management of cubitus varus deformities. Although a bigger study with a larger sample size, prospective in design, randomized if possible would be the ideal way forward to cementing our understanding of the outcomes of the approaches used.

Prospects for further research. A Randomized controlled trial (RCT) would go a long way towards validating our findings. Our study also suffered from the weakness of the study having a low number of patients and being retrospective in design.

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РЕТРОСПЕКТИВНЕ ПОРІВНЯННЯ ПАРАТРИЦИПІТАЛЬНОГО ПІДХОДУ ТА МЕТОДУ РОЗДІЛЕННЯ ТРИГОЛОВОГО М'ЯЗУ ДЛЯ ЛІКУВАННЯ ВАРУСНОЇ ДЕФОРМАЦІЇ ЛІКТЬОВОГО СУГЛОБУ ШЛЯХОМ КОРЕКТИВНОЇ ОСТЕОТОМІЇ

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Резюме. Корективна остеотомія варусної деформації ліктьового суглобу може бути проведена двома шляхами – через розділення триголового м'язу та паратриципітальним методом. Метою нашої роботи було порівняти функціональні наслідки розділення триголового м'язу та паратриципітального підходу для корективної остеотомії варусної деформації ліктьового суглобу. В жодному з попередніх досліджень не було проведено прямого порівняння доступів для остеотомії при варусній деформації ліктьового суглобу. Це ретроспективне дослідження виконано на основі оперативних втручань проведених з січня 2001 по грудень 2015 року. Загалом представлено 40 пацієнтів з варусною деформацією ліктьового суглобу. Критеріями виключення 10 пацієнтів було виключено з дослідження. Серед 40 пацієнтів, 22 було оперовано методом розділення триголового м'язу, 18 – паратриципітальним доступом. У всіх випадках стабілізація була досягнута внутрішньою

фіксацією. Післяопераційна іммобілізація забезпечувалася пластинами, накладеними вище ліктьового суглобу чи гіпсовою пов'язкою протягом трьох тижнів. Тривалість подальшого спостереження складала два роки. Дані було отримано ретроспективно. Для оцінки результатів хірурги в основному використовували систему функціональної оцінки наслідків Моррі. Окрім цього, хорошим результатом вважалася остеотомія, яка коригувала плечово-ліктьовий кут менше ніж на 10 градусів з протилежного боку. Наші остаточні дані склалися з 40 випадків. Усі двадцять два пацієнти в групі А були повністю задоволені косметичними результатами, але один пацієнт групи Б мав скарги на косметичний вигляд через надмірне латеральне виступання виростків. У групі А не було болю в сімнадцяти пацієнтів, легкий біль у трьох, помірний біль у двох випадках і жоден не мав сильного болю. У групі Б не було болю в п'ятнадцяти пацієнтів, легкий біль у двох, помірний біль в одному випадку і жоден не мав сильного болю. У жодному випадку не спостерігалось нестабільності в корональній площині. До теперішнього часу ні метод розділення триголового м'язу, ні паратриципітальний доступи не вважаються кращими за інші підходи. Здебільшого досвід хірурга та тип перелому визначають який розріз є доцільнішим. Порівняно з підходом розділення триголового м'язу, паратриципітальний підхід веде до кращих функціональних результатів, сили триголового м'язу, діапазон руху ліктьового суглобу та меншої контрактури розгинання в кінцевому періоді.

Ключові слова: розділення триголового м'язу, паратриципітальний доступ, функціональні наслідки, варусна деформація ліктьового суглобу, закрита клиноподібна остеотомія.

RETROSPECTIVE COMPARISON OF PARATRICEPITAL APPROACH AND TRICEPS SPLITTING APPROACH FOR THE MANAGEMENT OF CUBITUS VARUS BY CORRECTIVE OSTEOTOMY

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Conflicts of Interest

The authors declare no conflicts of interest.

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Received 23.03.2022

Accepted 06.09.2022